REMARKS

Claims 1 and 4-15 are pending. Claim 1 has been amended to better describe the invention. Applicants submit that the amendments are fully supported by the originally filed claims and specification, and that no new matter is added thereby.

Applicants' Invention

Applicants' invention relates to a method for cutting light-conducting fibers. One of the advantages of Applicants' invention over the prior art is that the resulting end surfaces after the cut have a very high degree of planar uniformity which minimizes or entirely eliminates any rework that needs to be done to the cut surfaces.

As mentioned in the application, while laser has been used to separate friable materials, what is known in the art is generally based on either heating the material to the transformation temperature or inducing a thermal stress in the material which leads to a break. The flatness of the end surfaces resulting from these methods typically is not satisfactory. The former method typically leads to rounded end surfaces where the fiber core protrudes more than the fiber coating because of the different thermal conductivity of the two materials from which the fiber core and the fiber coating are made (*see* Figure 1b of the application). The latter method affords little control over the quality of the end surfaces in terms of flatness. *See* [0009]-[0011] and [0034]-[0037] of the application as published in U.S. Patent Application Publication No. 2005/0105871.

Applicants have discovered that very flat end surfaces can be achieved by incremental ablation of fiber material using a laser beam with a specifically selected pulse regime.

As recited in claim 1, Applicants' method for cutting light-conducting fibers involves the following. A pulsed, disengaged operative laser beam is provided from CO_2 laser radiation. The parameters of the laser beam, including the pulse peak power ($\hat{P}$), the pulse half value duration (τ_{imp}), and the pulse frequency (f_{imp}), are selected such that each pulse ablates one elementary volume of material of the fiber to be cut. The unit of elementary volume is approximately equal to the product of the optical penetration depth into the fiber and the cross-section surface area of the incident operative beam. The operative beam is focused on the light-conducting fiber to be cut, which is fixed in place. The operative beam is then swept back and forth in a plane along a working zone over the fiber, so that each sweep causes ablation of a thin layer of fiber material

that comprises adjacent elementary volumes of fiber material. A cooling off phase is provided between each back and forth movement of the beam to cool the working zone. The back and forth movement of the operative beam, with the cooling phase in between, is repeated to remove incremental layers of fiber material until the fiber is cut through (*see e.g.*, Figure 4 of the application).

That the beam parameters are selected to ablate an elementary volume of the fiber material per pulse is an important aspect of Applicants' invention. While the Applicants' teachings extend to a stepwise cutting method that involves the removal of incremental volumes of fiber material, the unit elementary volume is specifically utilized such that ablation is effected exclusively in an optical absorption-controlled manner (*see* [0018] of the application as published in U.S. Patent Application Publication No. 2005/0105871). The unit elementary volume, as claimed and defined in the specification, is the product of the optical penetration depth (d) into the fiber material and the cross section area of the beam. As known by those skilled in the art, the optical penetration depth is inversely proportional to the linear absorption coefficient α, a wavelength-dependent constant, of the processed material. To remove such an elementary volume of fiber material by a single pulse of radiation, a precisely defined amount of pulse energy has to be applied. The energy of a pulse, as known by those skilled in the art, is obtained by the product of the duration τ_{imp} of the pulse and the peak power $\hat{P}$ of the pulse.

That the operative beam is caused to sweep back and forth in a plane along a working zone over the fiber is another important aspect of the invention. The back and forth movement allows ablation of adjacent elementary volumes of fiber material layer by layer, as opposed to depth ablation (i.e., ablating fiber material in the direction of the laser beam). The back and forth movement, together with the cooling period provided between each back and forth movement, allows each respective site of ablation to be sufficiently cooled before further ablation is effected at the same site. This keeps melting of the fiber material to an optimal minimum, which is crucial to ensuring the planar uniformity of the resulting cut surfaces.

Claim Rejections Under 35 U.S.C. § 103

Claims 1 and 4-15 are rejected under 35 U.S.C. § 103(a) as allegedly being unpatentable over U.S. Patent No. 6,246,026 ("Vergeest) in view of U.S. Patent No. 4,710,605 ("Presby"). Applicants respectfully traverse these rejections.

Applicants submit that neither Vergeest nor Presby, alone or in combination, discloses or suggests each and every limitation of amended claim 1. Vergeest merely discloses using a laser beam having short, high-energy pulses and passing a fiber through the pulsed laser beam in one stroke to cut the fiber (*see* Vergeest, col. 2, line 59 to col. 3, line 10). There is no disclosure or suggestion of using beam parameters that would allow each pulse of laser energy to ablate an elementary volume of fiber material, nor is there any disclosure or suggestion to use a laser beam that sweeps back and forth over the fiber so that each sweep causes ablation of a thin layer of fiber material that comprises adjacent elementary volumes of fiber material. As explained above, both of these limitations, in addition to providing a cooling period between each back and forth movement such that each respective site of ablation is sufficiently cooled before further ablation is effected at the same site, are essential to the effective removal of fiber material by vaporization while minimizing the amount of melting.

As detailed at pages 6 and 7 of the response to the first Office action, Presby discloses a thermal conductivity-controlled method that removes circumferential fiber material by gradually bringing a fiber into the edge of a laser beam. The theoretical basis by which the beam parameters are selected, the operation of the method, as well as the objective of the method are all different from the claimed invention. Accordingly, Applicants submit that like Vergeest, Presby fails to teach or suggest using beam parameters that would allow each pulse of laser energy to ablate an elementary volume of fiber material, as well as using a laser beam that sweeps back and forth over the fiber so that each sweep causes ablation of a thin layer of fiber material. The teachings of Presby therefore do not cure the deficiencies of Vergeest.

Since the respective and combined teachings of Vergeest and Presby do not disclose or suggest at least the above-mentioned limitations, Applicants submit that the invention as recited in claim 1 and claims that depend therefrom is not obvious in light of the cited references. Accordingly, reconsideration and withdrawal of the rejections of amended claim 1 and pending claims 4-15 are respectfully requested.

CONCLUSION

In light of the foregoing amendments and remarks, Applicants submit that claims 1 and 4-15 are in condition for allowance. If the Examiner believes that a telephone conversation with Applicants' attorney would expedite allowance of this application, the Examiner is cordially invited to call the undersigned attorney.

Respectfully submitted,

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Christine C. Vito
Attorney for the Applicants
Kirkpatrick & Lockhart Nicholson
Graham LLP
75 State Street
Boston, Massachusetts 02109-1808

Tel. No.: (617) 261-3150
Fax No.: (617) 261-3175

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